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$$\therefore \frac{v^2 x^3}{x^3 - r^3} = 2f(h+d) = \frac{2(1-\delta)(h+d)g}{1+\delta}$$

d can be found by either method in Vol. I, page 134.

202. Proposed by W. J. GREENSTREET, M. A., Editor of The Mathematical Gazette, Stroud, England.

Three equal, uniform, similar rods AB , BC , CD , freely jointed at B and C , are hung from a point by two equal strings attached at A and D . Find the position of equilibrium.

Solution by G. W. GREENWOOD, M. A., Dunbar, Pa.

By symmetry, the strings, of length l , say, make equal angles with the vertical, as do also the rods AB and DC ; denote these angles by θ and ϕ , respectively. The rod BC is horizontal. Denote the length of each rod by a , the weight by w , and the depth of the center of gravity of the system below the point of support by z , the strings being regarded as weightless.

$$\begin{aligned} z &= [w(l \cos \theta + \tfrac{1}{2}a \cos \phi) + w(l \cos \theta + a \cos \phi) + w(l \cos \theta + \tfrac{1}{2}a \cos \phi)] / 3w \\ &= \tfrac{1}{3}[3l \cos \theta + 2a \cos \phi]. \end{aligned}$$

For equilibrium, the value of z must be a maximum.

$$\therefore 0 = 3l \sin \theta d\theta + 2a \sin \phi d\phi \dots (1).$$

Also, by horizontal projection,

$$a = 2l \sin \theta + 2a \sin \phi \dots (2).$$

$$\therefore 0 = l \cos \theta d\theta + a \cos \phi d\phi \dots (3).$$

$\therefore 3 \tan \theta = 2 \tan \phi$ (by eliminating $d\theta$ and $d\phi$ from (1) and (2)). This equation, with equation (3), gives the position of equilibrium.

Also solved by G. B. M. Zerr and J. Scheffer.

AVERAGE AND PROBABILITY.

187. Proposed by HENRY HEATON, Belfield, N. D.

Through every point of a given square straight lines are drawn in every possible direction, terminating in the sides of the square. What is the average length of such lines?

II. Solution by G. B. M. ZERR, A. M., Ph. D., 4243 Girard Avenue, Philadelphia, Pa.

Let $ABCD$ be the given square, side a . P the random point coordinates (u, v) . On account of the symmetry of the square we will confine P to the triangle ADC . Let EQ be the random line through P , $m = \tan \theta = \tan QED$. For the area AOD , E must fall on HF to intersect opposite sides and on AH to intersect adjacent sides. For the area COD , E must fall on